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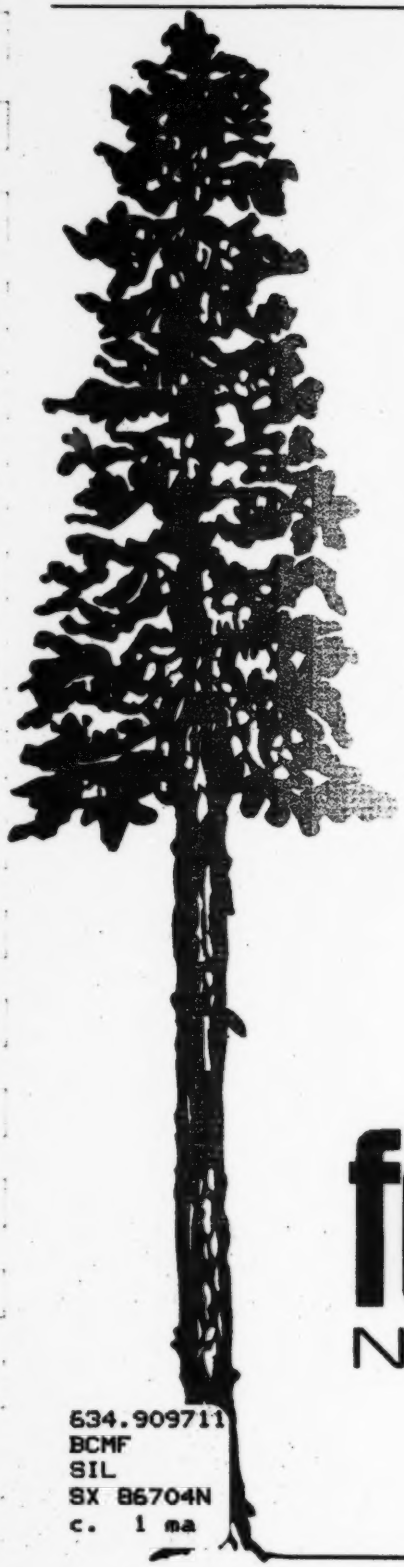

SX 86704N

Efficacy Testing of Hexazinone (Velpar-L®) and a Manual Treatment on Cottonwood and Thimbleberry in the ICH mw2

D.L. DeLong RPF
C.F. Thompson MF RPF

Technical Report TR-001

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ABSTRACT

This SX trial was established in the Kootenay Lake Forest District to evaluate the efficacy of hexazinone (Velpar-L®) and a manual brushing treatment on Black cottonwood (*Populus trichocarpa*) and Thimbleberry (*Rubus parviflorus*). The effects of these treatments on immature Engelmann spruce (*Picea engelmanni*) were also monitored. The study site is located in a 30 ha cutblock in the ICH mw2 subzone (Braumandl and Curran 1992). Four treatments were established in 0.075 ha units: two levels of hexazinone (2 and 4-mL), manual brushing and a control. The herbicide was applied in May 1986 and the manual treatment was completed in July 1986. Assessments were conducted pre-treatment, post-treatment (fall 1986) and two (fall 1987) and four (fall 1989) growing seasons after treatment. Velpar-L® caused mild injury to thimbleberry and moderate to severe injury to cottonwood. The manual treatment appeared to be ineffective in controlling thimbleberry but had some effect on cottonwood. The change in height and diameter of the spruce was constant in all treatment units including the control, suggesting that the treatments did not have an effect on the growth of spruce. This trial was not replicated, therefore descriptive statistics (means) are presented and only obvious trends are discussed. A study with replication would have been a more useful design, as the efficacy of Velpar-L® and manual brushing treatments can be influenced by weather and site specific properties.

ACKNOWLEDGEMENTS

The authors would like to thank Larry Hanlon, Jim Annunziello and Gord Grunerud of the Kootenay Lake Forest District for their cooperation and assistance during the study; Emilee Fanjoy of the Nelson Forest Region for assistance with data collection; and Ginny Garner of the Nelson Forest Region for assistance with report preparation. Delee Anderson and Michel Valee, formerly of the Kootenay Lake Forest District, were instrumental in the initiation of this project.

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INTRODUCTION

In the Interior Cedar Hemlock (ICH) zone of the southern interior of British Columbia, several species of non-crop vegetation can interfere with the establishment, survival and growth of coniferous crop trees. Availability of light, water and nutrients can be reduced by the non-crop vegetation. Several studies in the Pacific Northwest have shown that conifers perform best when competing vegetation is minimized (Lavender et al. 1990).

This SX trial was initiated in the Kootenay Lake Forest District to evaluate the efficacy of hexazinone (Velpar-L®)[1] and a manual brushing treatment on Black cottonwood (*Populus trichocarpa*) and thimbleberry (*Rubus parviflorus*), and to monitor the effects of these treatments on immature Engelmann spruce (*Picea engelmannii*). Although there has been considerable success with glyphosate (Vision®, formerly Roundup®) in controlling these non-crop species (Malik and Vanden Born 1986; D'Anjou 1990; Lepage et al. 1991), hexazinone may also be effective on this site. Hexazinone has provided good to excellent control of grasses and forbs in several studies in Washington, Oregon and Montana (Petersen 1982; Dimock et al. 1983; White and Newton 1984; Boyd et al. 1985).

Glyphosate and hexazinone differ in their mode of action. Glyphosate is absorbed almost exclusively via plant foliage. It is believed to inhibit the formation of essential amino acids in plants, which leads to metabolic failure and death of many plant species (Newton and Knight 1981). It is strongly adsorbed onto soil particles, becoming immobile and largely unavailable for root uptake (Ghassemi et al. 1981). The herbicide is most effective when applied directly to the foliage in the fall before leaf fall. Usually it is applied by backpack sprayer or by aerial methods.

Hexazinone behaves differently than glyphosate in that it is a soil-active chemical. It is applied to the soil surface, and absorbed from the soil solution by plant roots, and translocated upward to the foliage. Although the precise mode of action is unclear, hexazinone is thought to act as a photosynthesis inhibitor (Ghassemi et al. 1981). Hexazinone is recommended for use on medium textured, well-drained soils. In organic and finer textured clay soils, hexazinone can be adsorbed, becoming unavailable for root uptake. Therefore, very high levels of application are needed for the herbicide to be effective (Cantrell 1985). It is not recommended for use on wet soils as it is highly mobile and can move several meters through soil (Beaudry 1990). Treatments are most effective when applied in early spring, just before or during the period of active growth. Velpar-L® is usually applied directly to the ground with spot guns. Aerial methods are not recommended. Given its characteristics, Velpar-L® may complement glyphosate in vegetation management and thereby extend the window available for vegetation control from spring through fall.

EVALUATION

Study Site

The study site is located in a 30 ha. cutblock in the ICH mw2 subzone (Braumandl and Curran 1992) near the confluence of the Lardeau River and Rapid Creek in the Kootenay Lake Forest District (Figure 1). Table 1 presents study site parameters. The cutbock was clearcut and burned in 1970, and planted with 1250 stems per hectare of Douglas-fir (*Pseudostuga menziesii var. glauca*) and Engelmann spruce in 1972. In 1983 it was manually brushed, and then became rapidly reinvaded by cottonwood and thimbleberry.

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[1] Hexazinone was not registered at the time treatment was applied.

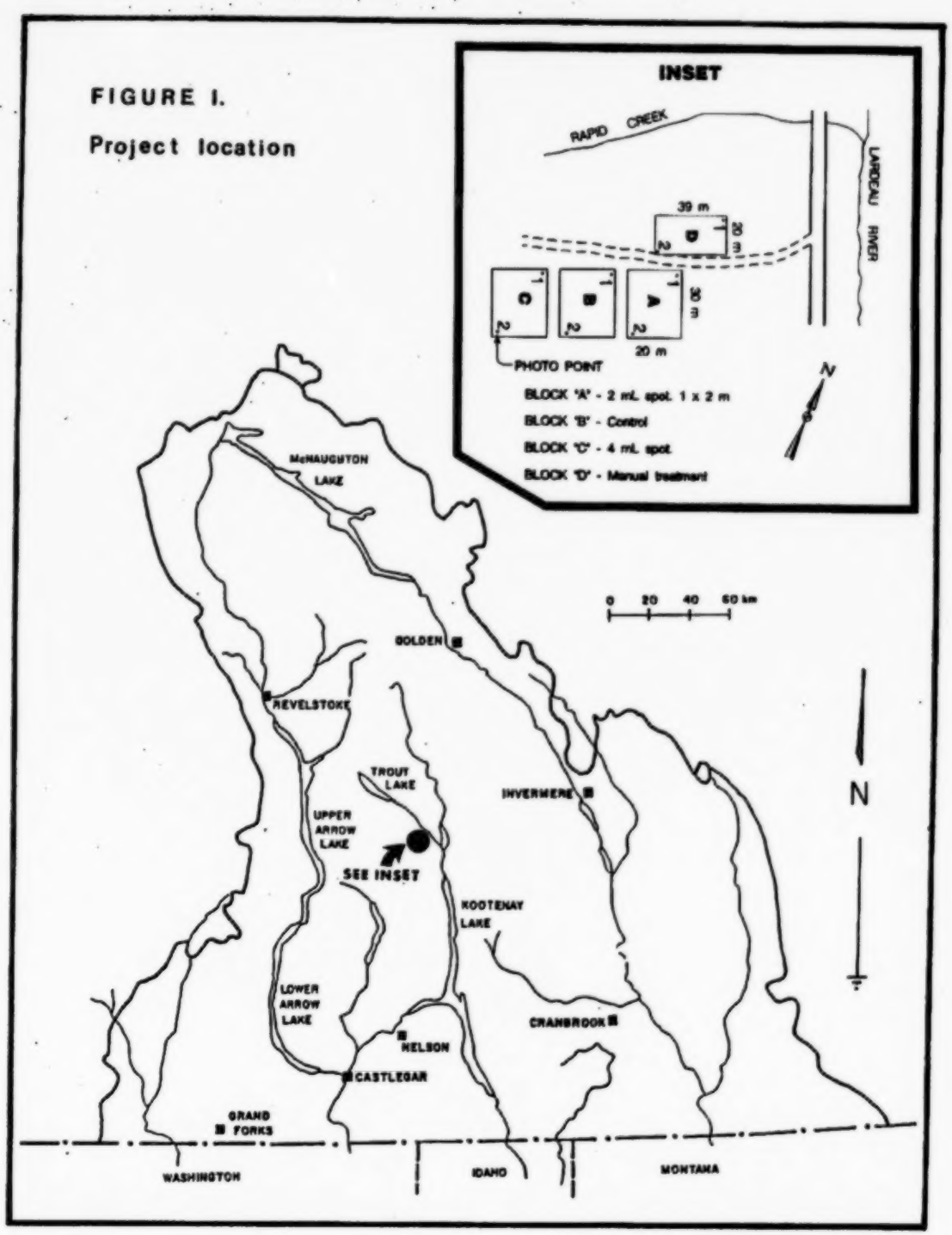

FIGURE 1. Treatment unit layout

TABLE 1. Study Site Parameters

Total area	0.3 ha
BGC subzone	ICHmw2
Site series	04
Aspect	Flat
Slope	5%
Slope position	Toe
Elevation	610 m
Edatope	3C
LFH depth	0.5 cm
Texture	SL
Coarse fragments	15-20%
Depth to imperm. layer	3 m

Study Methods

Four treatments were established in 0.075 ha. units (Table 2): two levels of hexazinone (2 and 4-mL) , manual brushing, and a control. The two levels of a liquid formulation of hexazinone (Velpar-L®) were directly applied to the soil with a spot gun on a 1 x 2 m grid in May 1986. In the manual treatment the thimbleberry and cottonwood were cut with powersaws July 22, 1986 (approximately 90 days after bud break).

TABLE 2. Treatment descriptions

Treatment	Ha.	Spots/ treatment	Dose/spot	Actual amount active ingredient applied in kg/ha (amount originally prescribed)
2-mL spot	.075	375	2 mL	2.77 (2.4)
4-mL spot	.075	375	4 mL	3.52 (4.8)
Manual	.075	-	-	
Control	.075	-	-	-

The treatments were monitored according to SX-0 trial guidelines in the B.C. Ministry of Forests Silviculture manual (1985). Twenty 10 m^2 (radius 1.78 m) plots were established in each of the four treatment units (Figure 1). In each plot, measurements were taken on the spruce crop trees and the target species, cottonwood and thimbleberry (Table 3). Assessments were conducted pre-treatment, post-treatment (fall 1986) and two (fall 1987) and four (fall 1989) growing seasons after treatment.

TABLE 3. Treatment plot measurements

Species	Measurement	Description
Cottonwood	Height	Total height to nearest 5 cm
	% Cover	Visual estimation of % plot occupied
	% Defoliation % Stem kill	Visual estimation on a 0-100 linear scale
	regrowth	Number of resprouted shoots
Thimbleberry	Height	Avg. height to nearest 5 cm
	% Cover	Visual estimation of % plot occupied
Spruce	Height	Total height to nearest 5 cm
	DBH	Diameter at breast height (mm)
	% Damage	Visual estimate of % damage due to treatment (discolored foliage)

Data Analysis

This trial was not replicated, therefore descriptive statistics (means) are presented and only obvious trends are discussed. A study with replication would have been a more useful design, as the efficacy of Velpar-L® and manual brushing treatments can be influenced by weather and site-specific properties.

RESULTS

Cottonwood

After one growing season almost all of the cottonwood stems were defoliated in the 2 and 4-mL Velpar-L® treatments, but only about half of the stems were actually killed. After two growing seasons most of the defoliated stems were also dead (Table 4). The % cover of cottonwood in both the 2 and 4-mL Velpar-L® treatments was effectively reduced over the four growing seasons of the study (Figures 2 & 3). The 4-mL dose appeared to be slightly more effective than the 2-mL dose in reducing height and cover of the cottonwood. Over the study period, cottonwood was reduced to 25% of its pre-treatment height and 10% of its pre-treatment cover in the 2-mL treatment and to 6% of its pre-treatment height and 2% of its pretreatment cover levels in the 4-mL treatment (Table 5).

In the manual treatment, cottonwood resprouted vigorously after treatment and had a significantly higher number of sprouts than the other treatments over the four growing seasons. In all treatments, the average number of sprouts appeared to peak after two growing seasons (Table 4). Immediately after the manual treatment the cottonwood appeared to be growing at the same rate as the control. This is illustrated by the similar slopes of the control and the manual treatment lines in Figure 2. However, after four growing seasons the cottonwood had only achieved 56% of its pre-treatment height and 27% of its pre-treatment cover in the manual treatment (Table 5).

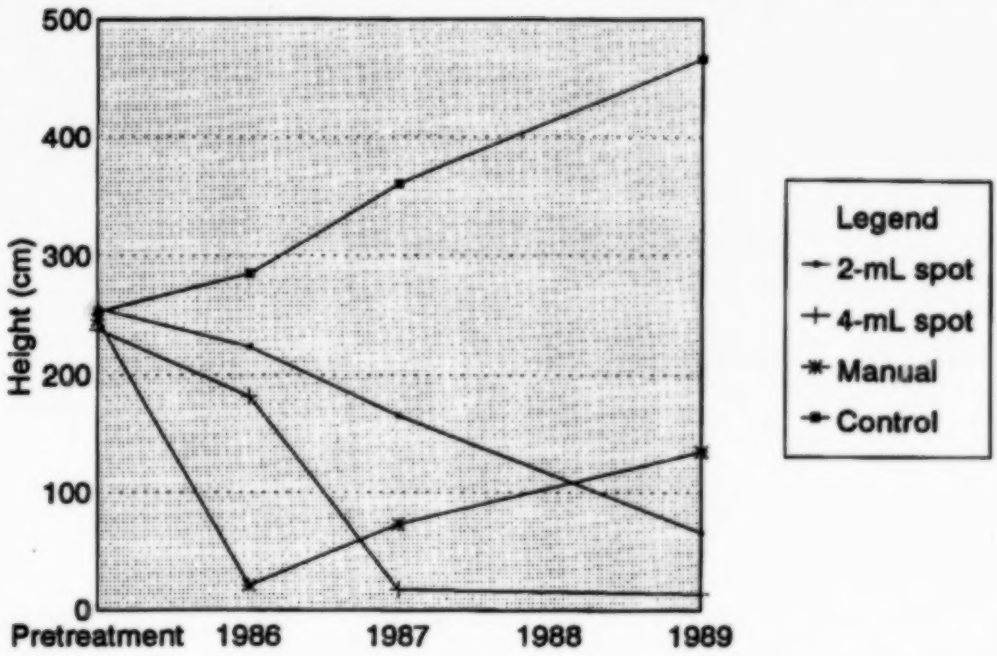

Figure 2. Average cottonwood height (cm) in the Rapid Creek trial.

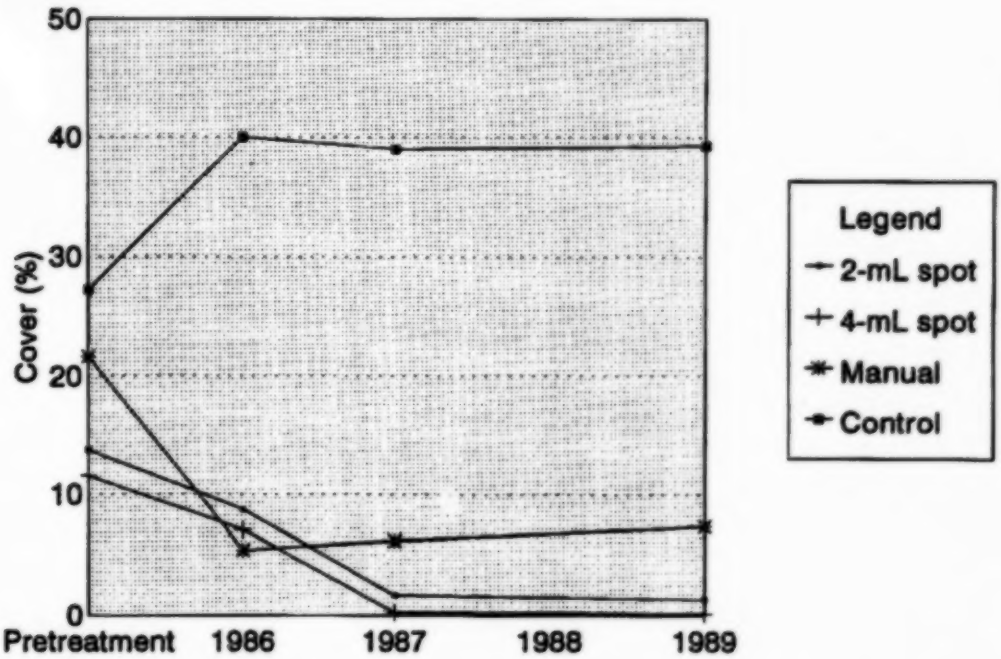

Figure 3. Average cottonwood cover (%) in the Rapid Creek trial.

TABLE 4. Cottonwood percent defoliation, percent stem kill and number of sprouts/stump

Treatment	After 1 growing season 1986			After 2 growing seasons 1987			After 4 growing seasons 1989[a]
	Avg. % defol.	Avg. % stem kill	Avg. no. of sprouts/ stump	Avg. % defol	Avg. % stem kill	Avg. no. of sprouts/ stump	Avg. no. of sprouts/ stump
2-mL	82.3	43.5	0.65	92.6	84.0	0.90	0.70
4-mL	94.3	52.3	0.05	94.7	94.7	0.25	0.10
Manual	-	-	24.6	-	-	31.75	12.21
Control[b]	6.5	3.3	0.55	3.5	2.5	1.25	0.20

a Defoliation and stem kill were not assessed after four growing seasons.
b Defoliation and stem kill in control caused by movement of Velpar-L® across bellin.

TABLE 5. Cottonwood height and percent cover

Treatment	Pre-treatment 1986		After 4 growing seasons 1989	
	Avg. height (cm)	Avg. % cover	Avg. height (cm) (% of pre-treatment)	Avg. % cover (% of pre-treatment)
2-mL	256.0	13.8	66.0 / (26)	1.4 / (10)
4-mL	238.3	11.6	14.0 / (6)	0.2 / (2)
Manual	246.3	21.6	134.7 / (56)	5.8 / (27)
Control	253.0	27.3	466.5 / (184)	39.3 / (144)

Thimbleberry

The 4-mL Velpar-L® treatment reduced the height and cover of thimbleberry immediately post-treatment. The 2-mL Velpar-L® treatment also reduced the height immediately post-treatment, but the cover was not reduced until after the first growing season. The manual treatment reduced the thimbleberry height initially, but it began to regrow vigorously after one growing season. The manual treatment appeared to have no effect on % cover of thimbleberry (Figures 4 & 5).

By the second growing season, the thimbleberry in all treatments began to regrow in height and cover, at the same rate or faster than the control (Figure 4 & 5)[2]. By the fourth growing season, the thimbleberry in the 2 mL treatment had regrown to 91% of its pre-treatment cover and to 101% of its pre-treatment height. In the 4 mL treatment, the thimbleberry had regrown to 90% of its pre-treatment height and 56% of its pre-treatment cover. The thimbleberry resprouted vigorously and surpassed its pretreatment height and cover by 7 and 33%respectively, in the manual treatment (Table 6).

[2] It is difficult to make direct comparisons with the control, as the thimbleberry pre-treatment height and % cover were significantly less than in all other treatments.

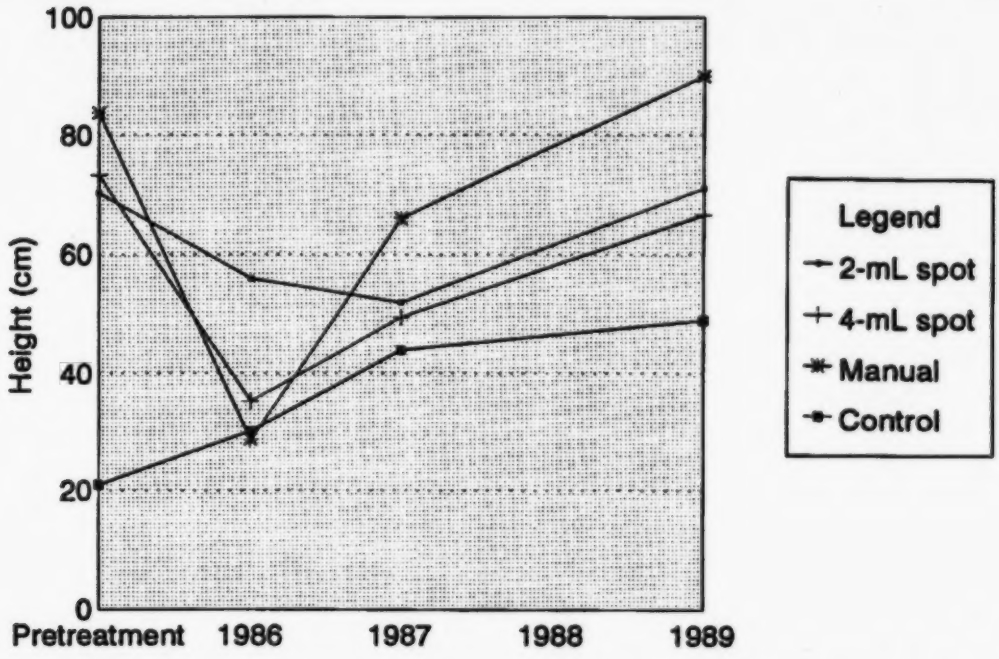

Figure 4. Average thimbleberry height (cm) in the Rapid Creek trial.

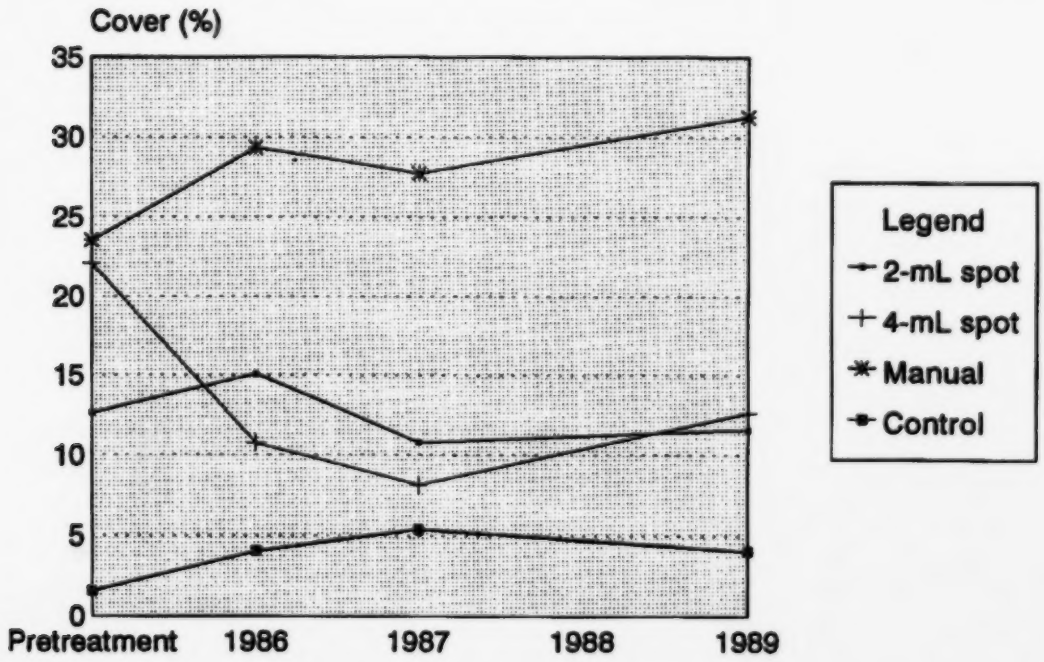

Figure 5. Average thimbleberry cover (%) in the Rapid Creek trial.

TABLE 6. Thimbleberry height and percent cover

Treatment	Pre-treatment 1986		After 4 growing seasons 1989	
	Avg. height (cm)	Avg. % cover	Avg. height (cm) (% of pre-treatment)	Avg. % cover (% of pre-treatment)
2 mL	70.3	12.7	71.0 / (101)	11.6 / (91)
4 mL	73.3	22.1	66.6 / (91)	12.7 / (57)
Manual	83.8	23.5	90.0 / (107)	31.3 / (133)
Control	21.0	1.6	49.0 / (233)	4.1 / (256)

Spruce

With the exception of the 2 mL Velpar-L® treatment, the pre-treatment heights and diameters of the spruce were not significantly different between treatment units in any given year. The trees in the 2 mL Velpar-L® treatment were larger at pre-treatment and remained significantly larger in height and diameter over the four growing seasons of the study. Figures 6 and 7 show that the growth rates[3] of the spruce trees remained constant over the period of the study. The Figures in Appendix 1 indicate that the spruce was generally taller than the cottonwood and thimbleberry in all the treatments at any time during the study.

Although attempts were made to keep the spots 1 m from the stem of crop trees, some Velpar-L® damage occurred in both treatment units. In the 4-mL Velpar-L® treatment unit, 8 trees out of 20 were damaged[4] in excess of 30%. In the 2 mL treatment, 4 trees out of 20 were damaged in excess of 30%. The damage did not appear to affect tree growth.

DISCUSSION

The 4-mL concentration of Velpar-L® was more effective on the target vegetation immediately post-treatment than the 2-mL concentration was, but after two growing seasons the difference became less pronounced. Both of the Velpar-L® treatments appeared to offer much more effective control of cottonwood than thimbleberry. Height and cover levels of cottonwood were reduced immediately after treatment and the effect appeared to last over the duration of the study. Velpar-L® seemed to cause only minor injury to thimbleberry, which began to recover within one to two growing seasons after treatment. These results are consistent with Coates et al. (1990) and D'Anjou (1990). Glyphosate has been a much more effective herbicide for controlling thimbleberry (Coates et al. 1990; LePage et al. 1991). The manual treatment appeared to be ineffective in controlling thimbleberry, which surpassed its pretreatment height and cover after four growing seasons. LePage et al. (1991) had similar results after a manual treatment on thimbleberry in the ICH zone near Smithers B.C. The cottonwood in the manual treatment resprouted after one growing season and surpassed the height and cover of the Velpar-L® treatments, but did not reach its pre-treatment levels. This suggests that the manual treatment offered some control, but was clearly not as effective as the Velpar-L® treatments on cottonwood.

The change in height and diameter of the spruce was constant in all treatment units, including the control,

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[3] Rate is the change in DBH and height over time.

[4] Red foliage on branch ends.

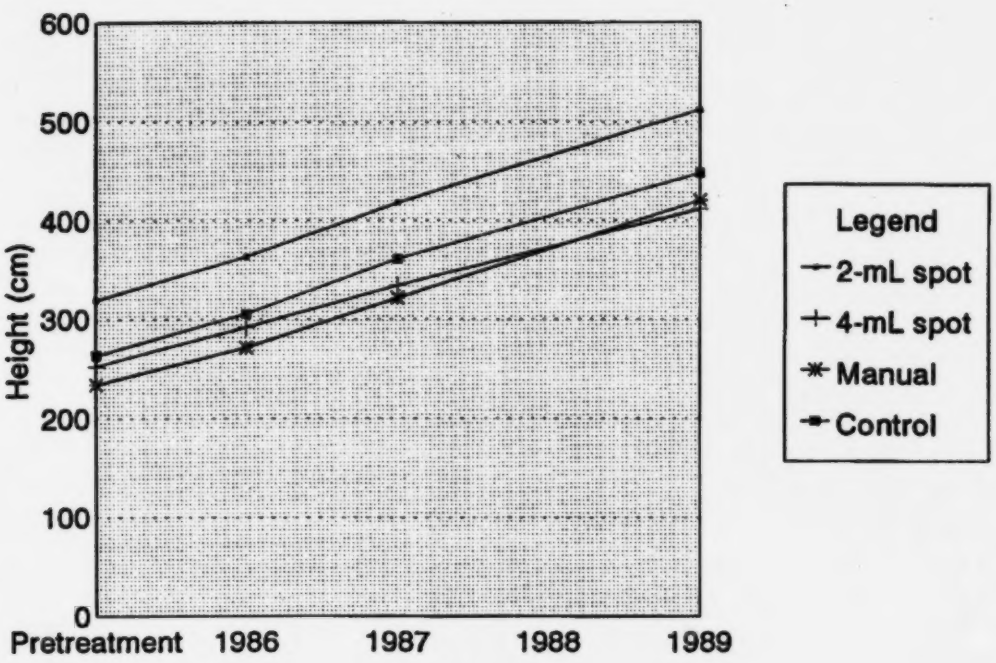

Figure 6. Average spruce height (cm) in the Rapid Creek trial.

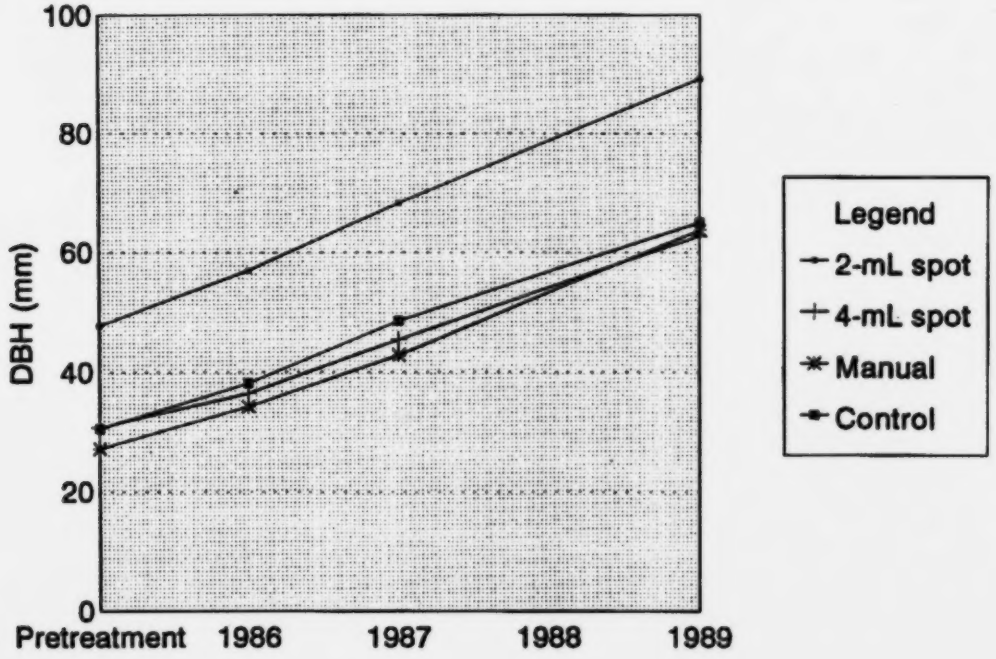

Figure 7. Average spruce DBH (mm) in the Rapid Creek trial.

suggesting that the treatments did not have an effect on the growth of the crop trees. It may have been that the vegetation was not the factor limiting spruce growth on this site. Although the mode of competition is not well understood for cottonwood or thimbleberry, thimbleberry is thought to compete primarily for light (Coates et al. 1990). Neither the cottonwood nor the thimbleberry was overtopping the spruce pre- or post-treatment. Although the growth of the crop trees in this study appeared to be unaffected by the damage caused by Velpar-L®, the treatment may have had a more severe effect on younger seedlings. White pine weevil (*Pissodes strobi*) damage was observed on spruce crop trees in each of the treatment units, however there appeared to be much lower levels of attack in the control. Other studies have also found evidence that brush that is over-topping spruce trees, may help protect the spruce leaders from white pine weevil attack (Cozens 1983; Perry 1988).

This trial is useful in testing the efficacy of Velpar-L® and manual brushing, but it is clear that more research is required to help us understand the role of non-crop vegetation in stand development over a rotation and to better predict and manage competition between crop and non-crop vegetation. Recent research initiatives are investigating the role of non-crop vegetation in ICH stand development and long-term stand productivity[5]. Even though several studies have shown that conifers perform best when competing vegetation is minimized, in some cases vegetation can have beneficial effects. Some deciduous trees currently regarded as weed species may have value as nurse crops (McLennan and Klinka 1990) or may have positive effects on forest productivity, ecosystem diversity, and the spread of *Armillaria* root disease (Simard 1990)[6]. It is clear that, given limited resources, the decision to control vegetation must be made carefully. As Kimmins and Comeau (1990) point out, vegetation management must be considered within the context of silvicultural systems over a rotation, and not in terms of individual stages of the rotation.

CONCLUSIONS

- Velpar-L® caused mild injury to thimbleberry and moderate to severe injury to cottonwood.
- Manual treatments applied approximately 90 days after bud break appear to be ineffective in controlling thimbleberry and of limited effect on cottonwood.
- Velpar-L® damaged 40 and 20% of the spruce crop trees in the 4-mL and 2-mL treatments, respectively.
- As there was no replication in this trial, more research should be completed to verify these findings.

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[5] Ian Cameron, Biometrician, Growth Models, B.C. Ministry of Forests, Research Branch, Victoria, B.C.; personal communication, April 1992.

[6] Further discussion of the positive aspects of vegetation cover can be found in Kimmins and Comeau (1990) and Lavender et al. (1990).

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APPENDIX 1

Figures of average height of vegetation in all plots

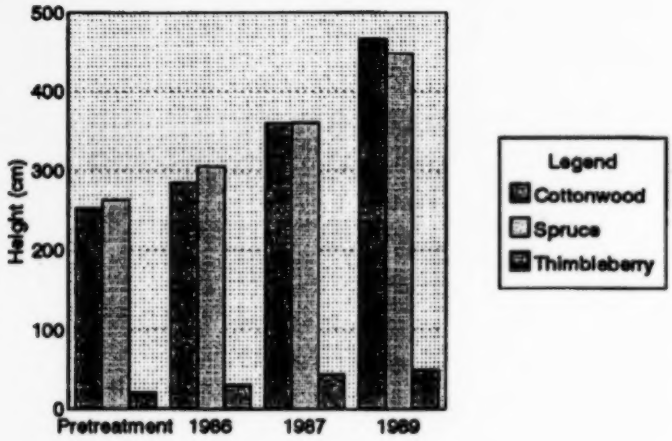

Figure 1a: Average height (cm) of vegetation in control plot.

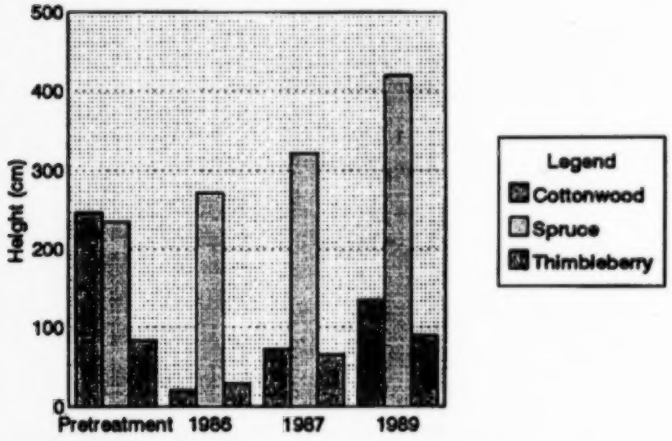

Figure 1b: Average height (cm) of vegetation in the manual plot.

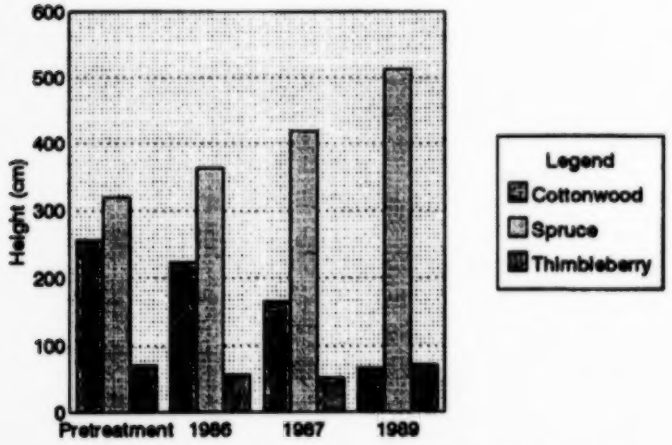

Figure 1c: Average height (cm) of vegetation in the 2-mL Velpar-L plot.

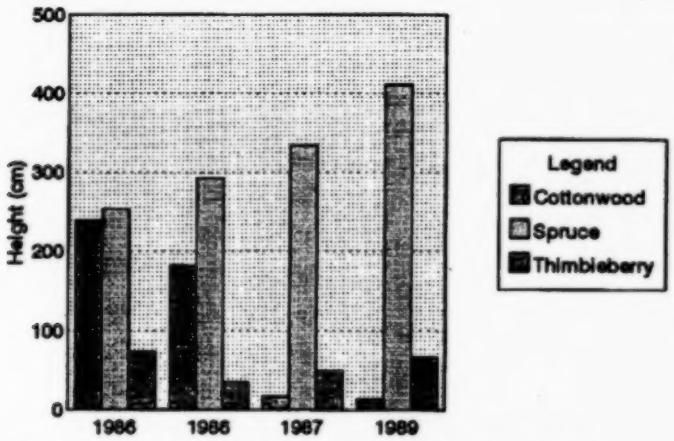

Figure 1d. Average height (cm) of vegetation in the 4-mL Velpar-L plot.